SIEMENS

L-828 Constant Current Regulator (50 and 70 kW/20 A)

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ETL Certified to FAA Specifications
AC 150/5345-10E

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RECORD OF CHANGES

Page	Rev.	Description	Chkd	App'd
1-3 to 1-7, 6-3, 6-4	B	Added information for 70 kW, 480 Vac CCR.	SP	VP
8-9, 8-11, 8-12	C	EC 00089. Deleted Figures 8-9, 8-11, 8-12. Added new Figure 8-9.	AS	VP
1-7	D	ECO 00880. Revised Table 1-7 to update input current.	MH	WT

TABLE OF CONTENTS

TABLE OF CONTENTS

List of TABLES

LIST OF ILLUSTRATIONS

SAFETY NOTICES

The operating and maintenance personnel should refer to FAA Advisory Circular AC 150/5340-26, "Maintenance of Airport Visual Aids Facilities" for instructions on safety precautions. Personnel must observe the safety regulations at all times. All operations on this unit shall be carried out by personnel qualified to work on high voltage equipment. While every practicable safety precaution has been incorporated in this equipment, the following rules must be strictly observed:

KEEP AWAY FROM LIVE CIRCUITS

Operating and maintenance personnel must at all times observe all safety regulations. Do not change plug-in components or make adjustments inside equipment with high voltage supply on. To avoid casualties, always remove power, then discharge and ground by use of a grounding rod, prior to touching any parts. See FAA Advisory Circular AC 150/5340-26 concerning safety.

RESUSCITATION

Operating and maintenance personnel should familiarize themselves with the technique for resuscitation found in the First Aid Instruction Manual.

WARRANTY

ADB, Inc. warrants that the L-828 Constant Current Regulators described herein, when sold by ADB, Inc. or its approved repr5esentatives, will perform in accordance with FAA specification AC 150/5345-10, L-828, and that any defect in design, materials or workmanship which may occur during proper and normal use during a period of one (1) year from date of installation or a maximum of two (2) years from date of shipment will be corrected by repair or replacement by ADB, Inc., f.o.b. factory. Damage resulting from improper installation does not constitute proper and normal use and is not covered by the warranty. Such corrections shall constitute the limit of all ADB, Inc. liabilities for the L-828 Constant Current Regulators.

1. SECTION 1. GENERAL INFORMATION AND REQUIREMENTS

1.1 Introduction

The ADB, Inc. oil-cooled 50 & 70 kW L-828 Constant Current Regulators (CCRs) are designed to supply five precision output current levels (20 amp maximum) for series lighting circuits on airport runways and taxiways. The output of the L-828 CCRs is accurately regulated within ±1% of the adjustable nominal current levels (see Table 1-1) from no load (short circuit) to full load and with input voltage variations of -5% to +10% of nominal. Output current levels are maintained even if 30 percent of the isolation transformers in the series lighting circuit supplied by the regulator have open secondaries.

1.1.1 Purpose

This manual describes procedures for the installation, operation, maintenance and troubleshooting of ADB, Inc. manufactured oil-cooled L-828 Constant Current Regulators.

1.1.2 Scope

This L-828 CCRS described in this manual are manufactured to FAA specification AC 150/5345-10E. Operation outside the design limitations of this specification may result in degradation of performance, damage or failure of regulator components or hazardous conditions.

1.2 Construction

See Figure 8-1. The oil-cooled regulators consists of a painted steel-top cabinet and bottom oil tank. An aluminum card rack mounted inside the top cabinet is connected to the regulator by plug-in connectors. The control logic is contained in plug-in modules in the card rack and is divided into two separate modules: the Input Module PCB, and the Current Controller PCB. The oil tank contains the cooling oil and all the power components: the power transformer and capacitors. An oil drain plug/sampling valve is provided on the bottom rear of the oil tank, and an oil gage is provided to indicate the oil level in the tank.

1.3 Modules

1.3.1 Input Module PCB

The input module printed circuit board (PCB) receives:

- Remote control signals
- Output current
- 48 V dc signals.

The Input Module PCB outputs the following signals to the current controller:

- DC power supply voltage
- A signal proportional to the output current
- A phase reference signal to control the firing of the SCRs
- 48 V dc for on/off control
- A signal to set the output current according to the brightness setting.

1.3.2 Current Controller PCB

The Current Controller PCB receives signals from the Input Module PCB and performs the following functions:

- Produces SCR-drive signals in accordance with the signals from the Input Module PCB
- Detects an overcurrent, open circuit or undervoltage, and switches the CCR off.

1.4 Equipment Data

The ADB part numbers for the L-828 CCRs are given in Table 1-2. Reference data pertinent to the equipment is listed in Table 1-3. Information on items not supplied but which might be required for installation is given in Table 1-4. Equipment and accessories supplied are listed in Table 1-5. Table 1-6 lists input power supply wire, while Table 1-7 lists input current for L-828 CCRs.

1.5 Protective Devices

The following protective devices are provided on each regulator:

- Output open-circuit protection
- Output overcurrent protection
- Input power line undervoltage protection
- Lightning arrestors on output bushings (Input lightning protection can be ordered as an option for 480 V ac and less input voltages.)
- Fuse protection of : AC supply voltage of the Input Module PCB, brightness control voltage for local control, and regulator control supply on primary and secondary.

1.6 Regulation

See Table 1-1 for output current limits. Current regulator is obtained under the following conditions:

- Load variations of zero (short-circuit) to full load with input voltage variations of -5% to +10%, at -40°C up to +55°C (-40°F to +131°F) ambient temperature.
- With up to 30% of the series-load isolation transformers open-circuited.

1.7 Panel Ammeter

A true rms-reading ammeter mounted on the front of the input module indicates the output current. The screw on the face of the ammeter is for zeroing adjustment of the indicator needle.

1.8 Input Power

The power transformer for the 50 or 70 kW L-828 CCR is designed for an input voltage of either 480 or 2400 V ac. The input voltage must be accurately determined prior to ordering the regulators as no alternate input voltage taps are available.

Table 1-1. Output Current Levels

5-STEP CCR BRIGHTNESS CONTROL SWITCH POSITION	NOMINAL RMS OUTPUT CURRENT (amperes)	OUTPUT CURRENT LIMITS (amperes)
5	20.0	19.40-20.30
4	15.8	15.33-16.27
3	12.4	12.03-12.77
2	10.3	9.99-10.61
1	8.5	8.24-8.76

Table 1-2. L-828 Part Numbers
Class 2 (20 amp maximum)

44D136X - X

Where,

X — X

Monitor Options
0 = 5 Step L-828—Scanning Monitor Ready*
3 = 5 Step Standard L-828

Rating/Input Voltage
4 = 50 kW (480 V ac)
5 = 50 kW (2400 V ac)
7 = 70 kW (480 V ac)
8 = 70 kW (2400 V ac)

* The L-828 regulator can be connected to an ADB Scanning Monitor. The ADB Scanning Monitor provides state-of-the art accuracy in computer monitoring of the status of L-828 regulators and the series circuits powered by them. In addition to providing all the functional capability of an FAA L-827 airport lighting monitor, the ADB Scanning Monitor's software-controlled monitoring can be easily changed to provide additional monitoring information or updated to monitor new equipment installed on the lighting circuits. Contact ADB Sales Department for details and additional literature.

Table 1-3. Equipment Data

FAA Type: L-828 (oil-cooled) Constant Current Regulator (CCR)

Rating: 50 & 70 kW

Input Voltage: 480 or 2400 V ac, -5%, +10%, single phase, 60 Hz ac.

Class 2 (20 A maximum output current)

Style 2: 5 step (8.5, 10.3, 12.4, 15.8 and 20 amps)

Power Factor: not less than 95%

Efficiency: not less than 93% (for 50 kW CCR) & 94% (for 70 kW CCR)

Reactive Loading: The CCRs maintain the current within the limits of Table 1-1 for all brightness steps when the load is connected via isolating transformers, and secondaries of 30% of these transformers become open-circuited. The load before opening the isolation transformer secondaries may be any value from half to full load.

Resistive Loading: The CCRs maintain the output current within the limits of Table 1-1 while powering any load between no load (short circuit) and full load. The regulation is maintained over the full range of environmental conditions specified below and for the input voltages specified above.

Oil Tank Capacity: 160 gallons (605.7 liters)

Environmental Operating Conditions: Designed for indoor use only in an area with adequate ventilation for cooling the constant current regulator.

Temperature Range: -40°C to +55°C (-40°F to +131°F)
Relative Humidity: 10 to 100%
Altitude: Sea level to 6,600 ft (2000 m)

Protective Devices:

Open-Circuit Protection — The primary switch is opened in less than 1 sec. after an open circuit occurs in the secondary. The open-circuit protective device is reset within 2 seconds after the rotary selector switch on the CCR is turned to OFF (or CCR is turned OFF while it is in REMOTE control) and reenergized, and is not tripped by switching of load circuits or other transients.

Table 1-3. Equipment Data

Overcurrent Protection — Regulators include an overcurrent protective device opens the primary switch when the output current exceed 20 amp by 5%. The device operates within 5 seconds after an overcurrent of 5% and within 1 second after an overcurrent of 25%. The device is reset within 2 seconds after the regulator is turned off and reenergized. The overcurrent protection is not activated by a momentary (0.25s) overcurrent caused by switching of load circuits or other transients.

Rating and Input Voltage	Dimensions in inches (Height x Width x Depth)	Weight in lb.
50 kW (480 V ac)	74.25 x 38.00 x 39.40 (1886 x 965 x 1001 mm)	3360 (1524 kg)
50 kW (2400 V ac)	74.25 x 38.00 x 39.40 (1886 x 965 x 1001 mm)	3460 (1569 kg)
70 kW (480 V ac)	74.25 x 38.00 x 39.40 (1886 x 965 x 1001 mm)	3460 (1569 kg)
70 kW (2400 V ac)	74.25 x 38.00 x 39.40 (1886 x 965 x 1001 mm)	3460 (1569 kg)

Table 1-4. Equipment not Supplied but Which Might be Required

Quantity	Description
A/R	Wire, input power 90°C, 600V or 5000 V minimum • AWG 2, 600 V for 50 kW/480 V ac CCR • AWG 1/0, 600 V for 70 kW/480 V ac CCR • AWG 8, 5000 V for 50 kW/2400 V ac CCR
A/R	Wire, alarm, AWG 19 minimum, AWG 14 maximum
A/R	Wire, remote control, AWG 19 minimum, AWG 14 maximum
A/R	Wire, ground, AWG 6 minimum
A/R	Wire, output load, AWG 8, 5000 V dc, L-824 type
A/R	Wire, shorting jumper, AWG 8 minimum
1	Disconnect switch or main circuit breaker
A/R	Input lightning arrestor [for 50kW (2400 V ac) CCRs use standard 2400 V ac lightning arrestors (customer supplied) external to CCR]
	ADB input varistor assembly 94B0011-1 is available for 480 V ac 50/70 kW CCR
1 each	Screwdriver: Blade Width 0.1 - 0.14 inches (2.5 - 3.5 mm) 0.14 - 0.2 inches (3.5 - 5 mm) 0.16 - 0.24 inches (4 - 6 mm) 0.24 - 0.31 inches (6 - 8 mm)

Table 1-4. Equipment not Supplied but Which Might be Required	
1	Uninterruptable power supply
2	External alarm
1	Voltmeter (for 480 V ac CCRs—minimum 600 V ac scale)
1	Voltmeter (for 2400 V ac CCRs—minimum 3000 V ac scale)
1	Voltmeter, 60 V dc full scale
1	Ammeter, true rms-reading , 25 amp maximum scale
1	Ohmmeter
1	2400 V step-down transformer (for 2400 V ac CCRs, such as, OLSUN 9219S-25995, 2400/240 Vac, 0.5 kVA)
1	Extended board, ADB 44C1123
4	Ring-tongue terminals (for input/output wire)
4	Mounting bolts (1/2-16 x 1 1/2 inches long) and washers (1/2 STD) and lockwashers

☑ **Note**: See Table 6-2 for recommended spare parts.

Table 1-5. Equipment Supplied	
Quantity	Description
1	L-828 Constant Current Regulator
1	Instruction Manual

Table 1-6. Recommended Input Power Supply Wire

(Recommended Input Wire: 90°C, 600V or 5000V minimum)

kW Rating	480 V Input	2400 V Input
50 kW	AWG 2, 600V	AWG 8, 5000V
70 kW	AWG 1/0, 600V	AWG 8, 5000V

☑ **Note**: It is recommended that the circuit breaker on the input power supply lines have a rating of 125% of the CCR's input current, as given in Table 1-7, unless local codes require a different rating technique. See the CCR's nameplate for the kW rating and input voltage to determine the input current from Table 1-7. If no standard size circuit breaker exists at the 125% value, use the next larger standard size circuit breaker.

Table 1-7. Input Current for L-828 Constant Current Regulators

Rating	480 Vac Input	2400 Vac Input
50 kVA	136 A	27 A
70 kVA	188 A	38 A

2. THEORY OF OPERATION

2.1 Introduction

A resonant network T1-C1 to T1-C50 (or T1-C60 for 70 kW CCR) feeds the output circuit independent of the impedance of the load with a current proportional to the value of the input voltage. Control and regulation of the output current is accomplished by the SCRs Q1 and Q2 which shunt progressively a part of the resonant circuit, decreasing the output current. The components of the resonant network are designed to deliver an output current slightly higher than 20 amp for the minimum input voltage, the SCRs being in the OFF state.

2.2 Output Current Measurement

The output current flows through the high voltage current transformer T2. The secondary of this transformer delivers a nominal current of 20/6.6 amp to the rack when it is used on the input module for:

1. The true rms-reading ammeter on the input module to indicate output current.
2. The step-down current transformer T1 (on Input Module PCB) which supplies a reduced proportional current to the current controller for control of the regulator output.

2.3 Mother Board

See Figure 8-8. The function of the mother board is to : (1) prevent wiring errors between modules, and (2) provide fast connect/disconnect feature.

2.4 Optional Extender Board

The extender board is used to facilitate testing and temporary adjustment of PCBs. It is inserted into the mother board PCB assembly, and the PCB to be tested or adjusted is then inserted into the extender board.

2.5 120 VAC to 48 VDC Interface

See Figure 8-5. Remote control of the CCR is accomplished by using +48 V dc signals. The 120 V ac to 48 V dc Interface PCB allows the CCR to be remotely controlled using 120 V ac signals. The 120 V ac signals are input at TB6 and energize a relay. The +48 V dc is connected to the wiper of each relay. When a relay is energized, the corresponding +48 V dc is input into the Input Module PCB through connector J4 on the mother board.

3. OPERATION

3.1 Control

The rotary selector switch S2 on the front panel of the regulator is used for local control of the regulator. This control switch has seven positions labeled: REM (remote), OFF, and brightness steps 1, 2, 3, 4 and 5.

3.1.1 Local Control

See Figure 8-2.

a) Rotary selector switch (S2) positions 1 through 5 are for local operation of the regulator. Positions 1, 2, 3, 4, and 5 provide an output current of 8.5, 10.3, 12.4, 15.8 and 20 amp, respectively. The regulator will automatically maintain the output current within ±1% of the nominal value for the brightness position selected.

b) When rotary selector switch S2 is se to the OFF position, the regulator is deenergized and can not be remotely turned on.

☑ **Note**: Before removing any modules (such as the input module or current controller) from the card rack, turn rotary selector switch S2 to the OFF position, and then turn switch S8 on the card rack to OFF.

c) When switch S2 is set to REM, operation of the regulator is by remote control signals.

3.1.2 Remote Control

See Figure 8-2.

a) When the rotary selector switch S2 is set to the position REM and remote control wiring is connected to remote control terminal block TB1 on the regulator, the output current of the regulator will correspond to the brightness setting energized by remote control signals. Remote control signals generated from a remote location have no control over the regulator when switch S2 is set to OFF.

b) When there are no remote control connections on terminal block TB1, the position REM becomes an additional OFF position, i.e., the regulator is deenergized when S2 is set to REM.

3.2 Shutdown Procedure

Set rotary selector switch S2 to position OFF, and then set switch S8 on the card rack to OFF. Power to the output bushings is now off, and the regulator cannot be energized by remote control signals. Power is still present on the input bushings. To remove input power, disengage disconnect switch or main circuit breaker.

3.3 Adjustments

The regulator has been adjusted at the factory to provide the nominal output current levels as given in Table 1-1. If the current level settings need to be adjusted, read the following warning statement before proceeding.

WARNING

Only personnel qualified to work on high voltage systems should attempt to make any adjustments on the constant current regulator.
Turn rotary selector switch S2 on the front panel of the regulator to position OFF, and turn switch S8 on the card rack to the OFF position before removing any modules from the card rack.
Before attempting to service the regulator, remove input power by turning off disconnect switch or main circuit breaker.
If the regulator deenergizes suddenly, the output circuit could be interrupted by an overcurrent, open-circuit or undervoltage condition. Turn rotary selector switch S2 to position OFF and disconnect the input power (turn off main circuit breaker or disconnect switch) before inspecting the output circuit.
Without this precaution, a dip in the power line may produce an on-cycling and reenergize the regulator, causing an output voltage of several hundreds or thousands of volts to be present.
These high voltages can cause serious injury or death.

3.3.1 Output Current Adjustment

Potentiometers are provided on the Input Module PCB and Current Controller PCB to permit adjustment of the output current levels if not within the limits defined in Table 1-1.

a) Connect a clamp-on true rms-reading instrument (such as a Beckman "Tech 360" multimeter with Model CT-231 current clamp or equivalent) around one of the output current leads.

☑ **Note**: Because the output current waveform is not a true sine wave, the ammeter must be of the true rms type. Field instruments such as clamp-on ammeters and Simpson voltmeters will give erroneously low readings.

b) Set switch S8 on the card rack to OFF, and remove the Current Controller PCB from the card rack. Insert an extender board into the previous location of the Current Controller PCB, and then insert the Current Controller PCB into the extender board.

c) Energize the regulator locally, and set the rotary selector switch S2 to the maximum brightness position 5.

d) Turn potentiometer R25 on the Input Module PCB fully clockwise. See Table 3-1.

e) Adjust potentiometer R110 on the Current Controller PCB to obtain an output current of 20 amps.

f) Adjust the potentiometers of the other brightness steps, if necessary, without touching R110 anymore.

Table 3-1. Output Current Adjustment Potentiometers	
Rotary Switch S2 Position	Adjustment Potentiometer on Input Module PCB
1	R21
2	R22
3	R23
4	R24
5	R25

3.3.2 Overcurrent Adjustment

Read safety precautions in paragraph 3.3 before proceeding.

3.3.2.1 Direct Method

☑ **Note**: It is a good rule to short-circuit the output bushings of the regulator with a minimum AWG 8 wire before making this adjustment.

a) Place Current Controller PCB on an extender board.

b) Turn potentiometer R109 on Current Controller PCB fully clockwise.

c) Energize regulator by engaging disconnect switch or main circuit breaker.

d) Turn rotary selector switch S2 to maximum brightness position 5.

e) Adjust trimpot R110 on Current Controller PCB to obtain an output current of 21.0 amp measured with a precision true rms ammeter.

Adjustment: If measured voltage level equals approximately +12 V dc, then adjust R78 clockwise; If measured voltage level equals approximately –12 V dc, then adjust R78 counterclockwise.

f) Turn potentiometer R109 slowly counterclockwise until the regulator deenergizes in 3.5 seconds or less after reaching the new R109 position. Use one of the following methods in order to set R109 to the proper position.

g)

1. Oscilloscope Method: Connect an oscilloscope across C12 on the Current Controller PCB. Short the test points TP9 and TP10 on Current Controller PCB. Rotate potentiometer R109 clockwise until the voltage waveform (voltage across C12) starts to fall on the oscilloscope screen. The voltage waveform falls when the overcurrent-detection circuitry starts to operate.

2. Timing Method: Turn R109 clockwise until the regulator shuts down. Then turn R109 counterclockwise by 1/8 of a turn and reenergize regulator. Slowly turn R109 clockwise in short intervals, waiting approximately 5 seconds to determine if the R109 setting causes the regulator to shut off. Continue with this procedure until the R109 position is reached which causes the regulator to shut off.

3. Analog Voltmeter Method: Using a voltmeter (1 MΩ minimum input) measure the voltage across C12. Short the test points TP9 and TP10 on the Current Controller PCB. Rotate potentiometer R109 clockwise while observing voltage across C12 on the voltmeter. The correct R109 position is reached when the voltage starts to drop. The overcurrent detection circuitry starts to become operational when the voltages starts to drop. Remove the short across TP9 and TP10.

h) Switch rotary selector switch S2 from OFF to "5" five times to verify the overcurrent LED lights and the regulator shuts off.

i) Reset R110 to obtain an output current of 20 amps.

☑ **Note**: If the overcurrent LED is lit when CCR is turned off or to remote, turn R78 one turn counterclockwise (voltage will be +12 V dc) to desensitize it.

3.3.3 Undervoltage Adjustment

The regulator's undervoltage adjustment has been desensitized at the factory so that variations in input voltage will not deenergize the regulator. However, if it is desired that the regulator shut down when the input voltage drops below a certain level, the undervoltage adjustment (potentiometer R111 on the Current Controller PCB) can be activated. Correct undervoltage adjustment requires an adjustable AC supply voltage. Typical values of supply voltage in accordance with the position of potentiometer R111 on the Current Controller PCB are:

1. If R111 is turned fully clockwise:
   —Regulator deenergizes at 0.89 V_{nom} (V_{nom} = nominal input voltage)
   —Regulator energizes at V_{nom}

2. If R111 is turned fully counter-clockwise:
   —Regulator deenergizes at 0.78 V_{nom} (V_{nom} = nominal input voltage)
   —Regulator energizes at 0.86 V_{nom}

4. PERIODIC MAINTENANCE

4.1 GENERAL

This section establishes the maintenance procedures required for the L-828 constant current regulators. The maintenance tasks must be performed on a recurring basis to insure optimum performance, minimize service interruptions and avoid major breakdowns.

WARNING

Only personnel authorized to work on high-voltage equipment should perform maintenance on the regulator.

Operate regulator under local control (using rotary switch S2) when performing maintenance tasks on the regulator. This will prevent the regulator from accidentally being turned on and causing serious injury or death. Always switch S8 on card rack off before removing or inserting PCBs.

Deenergize regulator by turning rotary switch S2 to OFF, and remove input power to regulator by turning off disconnect switch or main circuit breaker before opening access door to service regulator.

4.2 PREVENTIVE MAINTENANCE

The preventive maintenance checks for the regulator are listed in Table 4-1.

4.3 SHORT-CIRCUIT TEST

WARNING

Since high open-circuit voltages may result by the opening of the primary of a series lighting circuit, only personnel authorized to work on high voltage equipment should be allowed to perform the short-circuit test.

1. Remove input power to regulator (turn off disconnect switch or main circuit breaker) and turn rotary switch S2 to OFF.
2. Remove leads from output bushings, and short output bushings using AWG #8 or larger wire.

3. Make sure the panel ammeter on the regulator is zeroed. If not, adjust screw on face cover so the needle is set to 0 amps.
4. Energize regulator and turn rotary selector switch S2 to the lowest brightness step (10 on a 3-step CCR, 1 on a 5-step CCR) and then to the remaining brightness steps. Check the output current on the ammeter at each step. The output current should be within the tolerance given in Table 1-1.
5. If the output current is not within the limits specified in Table 1-1, check the input voltage to the regulator. The supply voltage should be within -5% to +10% of the nominal input voltage given on the regulator nameplate.
6. Turn off disconnect switch or main circuit breaker to remove input power to regulator.
7. Disconnect the shorting jumper and reconnect output cable.
8. Close input power disconnect switch or main circuit breaker.

4.4 Open-Circuit Test

WARNING

Since high open-circuit voltages may result by the opening of the primary of a series lighting circuit, only personnel authorized to work on high voltage equipment should be allowed to perform the open-circuit test.

1. Remove input power to regulator (turn off disconnect switch or main circuit breaker) and turn rotary switch S2 to OFF.
2. Disconnect cables from output bushings.
3. Turn on input power to regulator.
4. Turn rotary selector switch S2 to the lowest brightness position (1). The open-circuit protective device should automatically deenergize the regulator in less than 2 seconds.
5. Turn rotary selector switch S2 to OFF. The open-circuit protective device should reset.
6. Turn rotary selector switch S2 to position "1". The regulator should turn on and then deenergize in less than 2 seconds.
7. If the regulator operation is satisfactory, turn rotary selector switch to OFF, and turn off disconnect switch or main circuit breaker before reconnecting the load.
8. After the load has been reconnected, turn on input power to regulator.

4.5 Removal and Replacement of Oil

Remove input power to regulator (turn off disconnect switch or main circuit breaker) before attempting to remove oil.

☑ **Note**: The oil fill value is located on the top rear of the tank, and directly below is the oil drain valve. Always use clean dry (no water present) oil (Shell Diala AX or Texaco #55). Oil does not contain any PCBs.

To remove old oil from the tank, open oil fill valve (at top of tank), and drain the old oil from the tank through the oil drain valve. Wash out any sludge deposits in the tank using clean dry oil.
To refill tank with oil, use a gear pump in order to avoid pumping air into the tank with the oil. Pump the oil into the tank through the oil drain valve on the bottom of the tank, and open the oil fill valve to allow air in the tank to escape.

The tank should be initially filled to a level slightly above the midpoint of the oil gauge on the tank (slightly above the middle of the two reference markers on the oil gauge). Wait approximately two hours for any air present in the oil to escape, and if necessary, pump additional oil into the tank to bring the oil level to the midpoint of the gauge.

Close the oil fill valve and drain valve, and remove pump. Wait at least two additional hours, and check the oil level to make sure it hasn't changed. If the level has dropped and the ambient temperature has not changed, add oil through the oil fill valve to bring the level back to the midpoint before turning the regulator on.

☑ **Note**: The oil level on the gauge will depend on the temperature of the oil. When the regulator is turned on, the oil will be heated by the regulator causing the level to rise on the gauge.

Approximately 160 gallons (605.7 liters) of oil are required for the 50 kW CCR.

Table 4-1. Preventive Maintenance Tasks

INTERVAL	MAINTENANCE TASK	ACTION
Daily	(1) Check all control equipment for proper operation (2) Check for alarm signal	(1) Check local and remote control (if used) on each brightness step. (2) If alarm signal occurs, check what has happened and correct.
Every Two Weeks	Check the number of lamp failures	Replace failed lamps.
Monthly	(1) Check input voltage (2)Check and record output current on each brightness step	(1) If input voltage is not within -5% to +10% of the nominal value specified on the nameplate of the regulator, notify power company to correct voltage. (2) Use a rms-reading instrument. Adjust current levels if out of tolerance (see Table 1-1 and Section 3.3.1).
Annually	(1) Check relays, wiring and insulation (2) Inspect housing for rust spots (3)Inspect lightning arrestor connections. (4) Perform a short-circuit test (5) Perform an open-circuit test (6) Check oil for presence of dirt and water	(1) Clean dirty or slightly pitted contactor contacts. Use a fine file for surface cleaning. Replace contacts that are excessively burned or pitted. Operate the local control switch S2 to check for proper operation of relays and contactors. Make sure input and output connections are tight and that there are no damaged wires or frayed or burnt insulation (2) Clean and touch-up rust spots with paint. (3) Tighten any loose connections. Replace charred or burnt wiring or broken arrestors. (4) See paragraph 4.3. (5) See paragraph 4.3. (6) Remove a one-pint sample of oil (replace oil removed from CCR with an equal amount of new oil) and submit to laboratory for dielectric test and analysis. If the dielectric strength is low or the oil is dirty, it should be replaced or filtered and dried to restore its dielectric strength. Wash out any sludge deposits on the core and coil assembly and in the tank with clean dry oil.
Unscheduled	Check load on regulator	At installation and subsequent load changes make sure that the *output voltage times the output current does not exceed the rated load* on the nameplate of the regulator.

5. TROUBLESHOOTING

5.1 Troubleshooting Table

The troubleshooting guide for the L-828 constant current regulator is given in Table 5-1.

WARNING

Only personnel authorized to work on high-voltage equipment should perform maintenance on the regulator.

Deenergize regulator by turning rotary switch S2 to OFF, and remove input power to regulator by turning off disconnect switch or main circuit breaker. Turn switch S8 on the card rack to off. Discharge capacitors and ground input and output bushings by using a grounding rod prior to touching any parts.

If regulator deenergizes suddenly, the output circuit could be interrupted by an overcurrent, open-circuit, or undervoltage condition. Before inspecting the output circuit. place rotary selector switch S2 in the OFF position and turn off disconnect switch or main circuit breaker. Without this precaution, a dip in the power line may produce an on-cycling and reenergize the regulator, resulting in an output voltage of several hundreds or thousands of volts which can cause serious injury or death.

5.2 Preliminary Troubleshooting

It is essential for rapid troubleshooting of the CCR that at least one set of spare PCBs (input module and current controller) be available.

The following is a check list of steps to perform:

1. Visually examine all areas of the CCR. Are there any burnt or loose connections/parts?
2. Is the input voltage present and within +10% to -5% of nominal?
3. Check all fuses.
4. Are the PCBs fully pushed into the card rack?
5. Are the relays on the front panel fully seated?
6. Are there any bent pins on the rear of the input module and current controller?
7. Are the wire harness connectors J3 and J4 fully seated?

8. Have the PCBs been adjusted in accordance with the instruction manual?
9. Has the Input Module and Current Controller PCB been replaced?
10. Replace SCR.
11. If CCR works in local but not in remote, check voltage on remote control lines. If 120 V ac remote control is used, visually check the Interface PCB to insure individual relay contacts are moving or "clicking". If not, check relays by swapping them. If they still don't work, check for 120 V ac at remote control terminal block TB1.
12. Can the CCR be reenergized by turning rotary switch S2 from OFF to step B1? If it can be, problem is due to open circuit or overcurrent.
13. Does relay K1 on front panel energize? If it does but CCR does not come on, the problem is bad contactor wiring/contactor/relay K1/step-down transformer or incorrect input voltage.
14. Does the CCR intermittently deenergize in both local and remote? If so, replace K1/check K1 socket and wiring.
15. Short the output of the CCR with an AWG 10 wire, and turn CCR on. If the regulator operates normally, problem is load related.
16. If the CCR turns on and then shuts off after a few seconds and the ammeter on the input module indicates 0 amps, the problem is either an open circuit or current transformer T2 is open. T2 can be checked by comparing the primary and secondary current readings.
17. If the CCR turns on and then shuts off after a few seconds and there is a high current reading on the input module's ammeter, the problem is an overcurrent. Adjust the output current accordingly.
18. If the CCR does not energize at all, check the Current Controller PCB's undervoltage adjustment. It is normally set fully counterclockwise to desensitize it.

5.3 Fuses

1. Input module fuses F1, F2, and F3 —
   - F1 (2A, 250 V) — Protects primary of T2 on Input Module PCB which supplies AC voltage for PHREF (SCR phase control signal) and DC power supplies on both input module and current controller (via lines VAC1 and VAC2).
   - F2 (2A, 250 V) — Protects contactor K2 or mercury relays K2 and K6 via relay K1 pin 6 on main assembly.
   - F3 (0.1A, 250 V) — Protects 48 V dc source (CCI)

   ☑ **Note**: The 48 V dc CCI signal is not connected outside the regulator when the 120 V ac to 48 V dc PCB is used.

2. Input power fuses F1 and F2 (on 50 kW/480 V ac CCR): Fuses F1 and F2 rated at 125A, 600V.
3. Step-Up/Down transformer T3 fuses—Fuses F3 and F4 (rated at 3A, 600V) on 50 kW/480 Vac CCRs protect transformer T3 which supplies 240 V ac to card rack. Fuse F1 (rated at 1A, 2400V) on 2400 V ac CCRs protects transformer T3 and T8 which supplies 240 V ac to the card rack and thermostat/heater R21.

On 2400 V ac CCRs, fuses F3 and F4 are replaced by fuses F1 and F2 with a rating of 0.63 A, 4800 V.

4. 120 V ac to 48 V dc Interface PCB Fuse F1—(rated at 1 A, 250 V) protects 120 V ac remote control source (CCI).

☑ **Note**: After replacement of any module, check the output current on all brightness steps and the overcurrent protection adjustment.

Table 5-1. Troubleshooting Guide

Problem: Regulator does not turn on	
Possible Cause	**Solution**
Main power supply off	Verify presence of input voltage.
Switched off due to overcurrent	Switch regulator off in local, wait 2 seconds and check if regulator now operates correctly.
Incorrect external wiring	If regulator works correctly in local but not in remote, check the remote control signals. Replace the input module if necessary.
Blown fuse	Replace any blown fuse. Check input supply voltage and insure that it is between -5% and +10% of the nominal value listed on the CCR nameplate.
Defective relay	Turn rotary selector switch S2 (on input module) to position B1. Check if relay K1 of the current controller is energizing. Check coil of main contractor K2.
Malfunction of undervoltage detection	If 48 V dc is present on current controller and CCR doesn't work, replace current controller. If +48 V dc is not present, replace input module.
Problem: Output current is always 20 A or more	
Possible Cause	**Solution**
	CAUTION Short the output bushings before switching the regulator on. Wire should be AWG 8 or larger.
Malfunction of output current control circuitry	• If problem exists only in remote mode, check remote control signals for more than one 48 V dc (or 120 V ac) control signal on brightness control terminals. • If problem occurs in remote and local mode, check the brightness step relays (K2, K3, ..., K5) on input module for proper operation. Measure voltage across relay coil to see if relay is energized or replace input module.
Overcurrent condition	See problem "Regulator turns on but deenergizes suddenly".

Table 5-1. Troubleshooting Guide

Problem: Regulator turns on but deenergizes suddenly.	
Possible Cause	**Solution**
	CAUTION Short the output bushings before switching the regulator on. Wire should be AWG 8 or larger.

Output circuit interrupted	Turn regulator on. If regulator works correctly, repair lighting circuit taking safety precautions into account.
Defective printed circuit board	Check regulator output current on panel ammeter. Replace input module and/or current controller if defective.
Overcurrent condition	• If no overcurrent (output current higher than 21.0 A) condition exists on the maximum brightness setting, then readjust the overcurrent protection. See Section 3.3.2. Verify the current is within nominal range (defined in Table 1-1) at all other brightness steps. • Verify the presence of voltage across R75 of current controller. (TP1: 0 V reference; TP8: voltage across R75; this is a rectified AC signal with a peak value of about 40 V max. at 20 A output current). If no voltage is present, replace input module. • Verify SCR ignition by replacing the current controller. • Check SCRs and wiring.

Problem: More than 2 seconds is required for CCR to deenergize on an open-circuit load	
Possible Cause	**Solution**
Faulty open-circuit protection	Replace current controller.

Table 5-1. Troubleshooting Guide

Problem: Short lamp life and/or high output current reading on panel ammeter	
Possible Cause	**Solution**
Incorrect output current adjustment	Proceed as in Section 3.3.1.
Faulty overcurrent protection	Replace current controller.

Problem: Output current is always 8.5 A or less.	
Possible Cause	**Solution**
Brightness relay on input module fails to pull in	If problem exists only in remote mode, replace input module. Verify existence of DC voltage on TB1 terminals B2, B3, B4 and B5.
Defective module	If problem exists in remote and local mode, replace input module to see if current transformer reacts correctly (low probable failure), or the brightness control relays K2, K3, ..., K5 work correctly.
SCRs always conducting	Verify SCR ignition by replacing current controller. Check SCRs and wiring for shorts in SCR circuitry.
Defective resonant circuit (transformer or capacitor)	• Visually inspect capacitor for damaged housing or wire connections. • Visually inspect transformer for damaged coils, connections and/or wiring. • To check capacitance, insure that (a) Output bushings are shorted, (b) R75 (on Current Controller PCB) is shorted (no output current detection, and (c) C7 (on Current Controller PCB) is shorted (no open circuit or overcurrent detection). • The capacitors are working properly if the output current at V_{nom} -5% is greater than or equal to 20.9 A; at V_{nom} is greater than or equal to 22.1 A; and at V_{nom} +10% is greater than or equal to 23.9 A. (V_{nom} is the nominal input voltage for the CCR.)

Problem: Regulator operates by local control switch S2, but does not operate by remote control	
Possible Cause	**Solution**
Rotary switch S2 (on input module) not set to "REM"	Set switch S2 to "REM".
Blown fuse	Check fuse F3 on input module. Replace if blown.
Loose or broken remote control wires	Check connections on remote terminal block TB1. If +48 V dc remote control signal used, use a DC voltmeter (60 V dc scale) to verify correct signals are received at CCR. If 120 V ac remote control signals are used, use an AC voltmeter (300 V ac scale) to verify correct signals are received at CCR.
Incorrect wire connections	See Table 7-1 and verify wiring connections are correct.

Table 5-1. Troubleshooting Guide

Problem: Regulator does not indicate proper current	
Possible Cause	**Solution**
Incorrect output current adjustment	Proceed as in Section 3.3.1.
Defective module	Replace input module.

Problem: Ammeter on CCR oscillates and a loud "growling" noise is present	
Possible Cause	**Solution**
Incorrect secondary connections on transformer T3 (if T3 has been replaced in the field)	Reverse the secondary connections on T3.

Problem: Output current cannot be adjusted up to 20 A	
Possible Cause	**Solution**
Regulator load is too large	Check if the *input current x input voltage x CCR efficiency* [=0.93 for 50 kW] [*or 0.94* for 70 kW CCR] is larger than the kW rating of CCR nameplate. If it is, either reduce the load or replace regulator with a larger kW CCR. This problem can also be verified by shorting the output of the CCR and verifying output current can be adjusted correctly in each step.

6. PARTS LIST

6.1 Parts List

Table 6-1 provides data on all replaceable parts for each repairable or replaceable component or assembly. Recommended spare parts in bold type.

NOTE

Substitution of electrical components may be done only if substitution is the exact physical equivalent (body or case size) and equal, or better electrical characteristics with respect to tolerance, failure rate and/or reliability.

Table 6-1. Parts List

General Assembly—50 kW CCRs

Item # Fig. 8-1	Description: 50kW/2400V 44D1365-0	Manufacturer Part No.	ADB Part No
LA1/2	**ARRESTOR,SURGE, 6 KV**	**COOPER PWR HXD60C0DA21**	**32A0024**
	CAPACITOR, 26 µF, 525 V AC, 6%	RONKEN P91D22266H05	20A0019
K2/K6	CONTACTOR ASSEMBLY	ADB 44C1410-2	44C1410-2
	CURRENT CONTROL ASSEMBLY	**ADB 44C1268**	**44C1268**
	HEATSINK	ADB 60B0670	60B0670
	INPUT MODULE ASSEMBLY	**ADB 44D1205**	**44D1205**
E1/E2	STANDOFF INSULATOR	GLASTIC 1461-1K	49A0086
S8	POWER SWITCH ASSEMBLY	ADB 44B1583	44B1583
K1	**RELAY, DPDT, 10A, 24VDC**	**P&B KUP-11D15-24**	**53A0173**
Q1/Q2	SCR BLOCK ASSEMBLY	ADB 44D1113	44D1113
T8	TRANSFORMER, 120/240V	TRIAD N-250 MG	35B0219
T6	TRANSFORMER, CURRENT 20/6.6A	TR TR14424	35A0308
T1	TRANSFORMER, POWER, 2400 VAC	BASLER 25443-001	35C0191
T3	TRANSFORMER, STEP DOWN 2400/120V	GE 763X21G42	35C0127

General Assembly—50 kW CCRs

Item # Figs. 8-1	Description: 50kW/480V 44D1364-3	Manufacturer Part No.	ADB Part No.
	ARRESTOR,SURGE, 6 KV	**COOPER PWR HXD60C0DA21**	**32A0024**
	CAPACITOR, 26 µF, 525 V AC, 6%	RONKEN P91D22266H05	20A0019
	CONT 3P 200A, 170 A, 240VAC	SIEM 3TF5222-OAP6	53A0333
	CURRENT CONTROL ASSEMBLY	**ADB 44C1268**	**44C1268**
	FUSE, 125A, 600V	**LF LLSRK 125**	**47A0106**
	FUSEBLOCK	LF LH60200 ICR	49A0097
	HEATSINK	ADB 60B0670	60B0670
	INPUT MODULE ASSEMBLY	**ADB 44D1205**	**44D1205**
	POWER SWITCH ASSEMBLY	ADB 44B1583	44B1583
	RELAY SOCKET	P&B 27E121	49A0075
	RELAY SPRING	P&B 20C314	49A0076
	RELAY, DPDT, 10A, 24VDC	**P&B KUP-11D15-24**	**53A0173**
	SCR BLOCK ASSEMBLY	ADB 44D1113	44D1113
	TRANSFORMER, CURRENT 20/6.6A	TR TR14424	35A0308
	TRANSFORMER, POWER, 480 VAC	BASLER 27432-001	35C0190
	TRANSFORMER, STEP-DOWN 480/240V	MAGTEK 211-051	35A0150

General Assembly—70 kW CCRs

Item # Figs. 8-1	Description: 70kW/480V 44D1367-3	Manufacturer Part No.	ADB Part No.
	ARRESTOR,SURGE, 6 KV	**COOPER PWR HXD60C0DA21**	**32A0024**
	CAPACITOR, 26 µF, 525 V AC, 6%	RONKEN P91D22266H05	20A0019
	CONT 3P 200A, 170 A, 240VAC	SIEM 3TF5222-OAP6	53A0333
	CURRENT CONTROL ASSEMBLY	**ADB 44C1268**	**44C1268**
	FUSE, 200A, 600V		**47A0141**
	FUSEBLOCK	LF LH60200 ICR	49A0097
	HEATSINK	ADB 60B0670	60B0670
	INPUT MODULE ASSEMBLY	**ADB 44D1205**	**44D1205**
	POWER SWITCH ASSEMBLY	ADB 44B1583	44B1583
	RELAY SOCKET	P&B 27E121	49A0075
	RELAY SPRING	P&B 20C314	49A0076
	RELAY, DPDT, 10A, 24VDC	**P&B KUP-11D15-24**	**53A0173**
	SCR BLOCK ASSEMBLY	ADB 44D1113	44D1113
	TRANSFORMER, CURRENT 20/6.6A	TR TR14424	35A0308
	TRANSFORMER, POWER, 480 VAC		35C0193
	TRANSFORMER, STEP-DOWN 480/240V	MAGTEK 211-051	35A0150

Table 6-1. Parts List (continued)

General Assembly—70 kW CCRs

Item # Figs. 8-1	Description: 70kW/2400V 44D1368-3	Manufacturer Part No.	ADB Part No.
	ARRESTOR,SURGE, 6 KV	**COOPER PWR HXD60C0DA21**	**32A0024**
	CAPACITOR, 26 µF, 525 V AC, 6%	RONKEN P91D22266H05	20A0019
	CONTACTOR ASSEMBLY	ADB 44C1410-2	44C1410-2
	CURRENT CONTROL ASSEMBLY	**ADB 44C1268**	**44C1268**
	HEATSINK	ADB 60B0670	60B0670
	INPUT MODULE ASSEMBLY	**ADB 44D1205**	**44D1205**
	POWER SWITCH ASSEMBLY	ADB 44B1583	44B1583
	RELAY SOCKET	P&B 27E121	49A0075
	RELAY SPRING	P&B 20C314	49A0076
	RELAY, DPDT, 10A, 24VDC	**P&B KUP-11D15-24**	**53A0173**
	SCR BLOCK ASSEMBLY	ADB 44D1113	44D1113
	TRANSFORMER	TRIAD N-250 MG	35B0219
	TRANSFORMER, CURRENT 20/6.6A	TR TR14424	35A0308
	TRANSFORMER, POWER, 2400 VAC		35C0194
	TRANSFORMER, STEP DOWN 2400/120V	GE 763X21G42	35C0127

Input Module Assembly

Item # Figs. 8-2	Description:	Manufacturer Part No.	ADB Part No.
13	5-STEP INPUT MODULE PCB ASSEMBLY	ADB 44D1205	44D1205
2	AMMETER	CMI MMCL27-1003	52A0098
7	**FUSE, 0.1A, 250 V, SB**	**BUSS MDL1/10**	**47A0068**
55	**FUSE, 2A, 250 V, SB**	**BUSS MDA2**	**47A0049**

120 V ac to 48 V dc Interface Assembly

Item # Figs. 8-5	Description:	Manufacturer Part No.	ADB Part No.
8	**FUSE, 1A, 250 V, SB**	**LITTELFUSE 326001**	**47A0017**
15	**RELAY, DPDT, 10A, COIL, 120 V AC**	**P&B K10P11A15-120 VAC**	**53A0183**
4	TRANSFORMER (240/120 V AC)	TRIAD-UTRAD FS 120-300	35A0220
17	**VARISTOR**	**GE MOVII V130LA2**	**32A0013**

Table 6-1. Parts List (continued)

High Voltage Contactor Assembly for 2400 V ac CCRs

Description:	Manufacturer Part No.	ADB Part No.
CONTACTOR, 100A, SINGLE POLE, N.O.	STYLE 29753	53A0201
STRIP HEATER, 240 V AC, 150W	CHROMALOX 129322	85A0054
THERMOSTAT	THERM-O-DISC 37T21	54A0007

Optional Equipment

Description:	Manufacturer Part No.	ADB Part No.
Extender Board Assembly	ADB 44C1123	44C1123

7. INSTALLATION

7.1 INTRODUCTION

This section provides instructions for the installation of the L-828 Constant Current Regulators. Refer to the airport project plans and specifications for the specific installation instructions.

7.2 UNPACKING

Unpack crate upon receipt and examine regulator to insure that no damage has occurred during shipment. Note any exterior damage to crate which might lead to detection of equipment damage. When handling the regulator, care should be taken to maintain the unit in an upright position.

7.2.1 Damage

If damage to any equipment is noted, a claim form should be filed with the carrier immediately. Inspection of equipment by the carrier may be necessary.

7.3 INSTALLATION

The regulator can be lifted using a forklift or gantry crane using the four eyebolts on the tank. Place regulator inside a well ventilated room with sufficient clearance for personnel to inspect and maintain the unit. Level the regulator so that the tank is not more than 5 degrees off of vertical.

Four 0.55 x 1.40 inch (13.97 x 35.56 mm) slotted holes (see Figure 8-1) are provided on the mounting channels of the regulator for bolting the CCR to the floor or rail. Use four (1/2-16 x 1 1/2 inch long) mounting bolts, (1/2 STD) washers and lockwashers.

Check oil gage. The oil level at 20°C (68°F) should lie between the high and low black line markings on the oil gauge. At temperatures above or below 20°C, there is a corresponding increase or decrease in oil volume. The oil-level reading will be high if the regulator is at operating temperatures or low if shut off and the ambient temperature is below 20°C.

7.4 WIRING CONNECTIONS AND STARTUP

WARNING

Installation and operation of the CCR should be performed by personnel qualified to work on high voltage equipment. The high voltage involved with the unit makes it potentially dangerous and may be lethal if contacted by operating personnel.

1. Verify the input supply voltage corresponds to the voltage rating on the nameplate of the regulator.

2. Make sure the rotary switch S2 on the front panel is set to the OFF position. Also, insure that the card rack switch S8 is set to OFF.
3. Ground the regulator by making an adequate ground wire (AWG 6 or larger) connection to the external ground lug on the regulator.
4. An appropriate disconnect-type cutout or circuit breaker shall be provided for the input power supply lines.
5. Short-circuit the output bushings E5 and E6 using AWG 8 (minimum) wire to avoid lamp destruction in case of excessive current output.
6. Install appropriate external lightning arrestors on the input power supply lines as close as possible to the CCR's input bushing E1 and E2.
7. Connect the power supply lines (see Table 1-4 for recommended input wire) from the disconnect switch or main circuit breaker to the CCR's input bushings E1 and E2. Tighten all connections.
8. Energize regulator (engage main circuit breaker or disconnect switch). Turn switch S8 on the card rack to the ON position, and turn rotary selector switch S2 (on the front panel) to all brightness steps. Verify current values on panel ammeter correspond to those in Table 1-1 for each brightness step.
9. Deenergize regulator (disengage main circuit breaker or disconnect switch), and turn rotary selector switch S2 and switch S8 to OFF.
10. Connect remote control lines, if required, to the remote control terminal block TB1 (use AWG 19, 300 V wire (minimum)) as indicated in Table 7-1 for +48 V dc control signals and Table 7-2 for 120 V ac signals. See Figure 8-10 for remote control and external alarm connections.

☑ **Note**: Do not connect an external 120 V ac power source to CCI on a 120 V ac to 48 V dc Interface PCB.

Table 7-1. Remote Control Connections

Terminal Block TB1 Label	Function
DM	Degraded Mode (monitor)
N	Remote Control Common
B1, B2, B3, B4, B5	Brightness Control
CC	On-Command Voltage (from remote control)
CCI	Remote Control Power

☑ **Note**: Tables 7-1 and 7-2 give the necessary connections for remote control. Terminal B1 does not need to be wired. Brightness step B1 occurs when the regulator is switched on.

Table 7-2. Remote 120 V ac Control Connections

5-STEP CCR	Remote Intensity Step	Connect CCI to
	8.5 A	CC
	10.3 A	CC, B2
	12.4 A	CC, B3
	15.8 A	CC, B4
	20.0 A	CC, B5
	OFF	nothing
	DEGRADED MODE	DM

☑ **Notes:**

a) In situations where the remote control lines are extremely long or in cases when there is the potential of noise voltage being generated on inactive control lines, an L-841 relay cabinet should be used to clean up the lines.

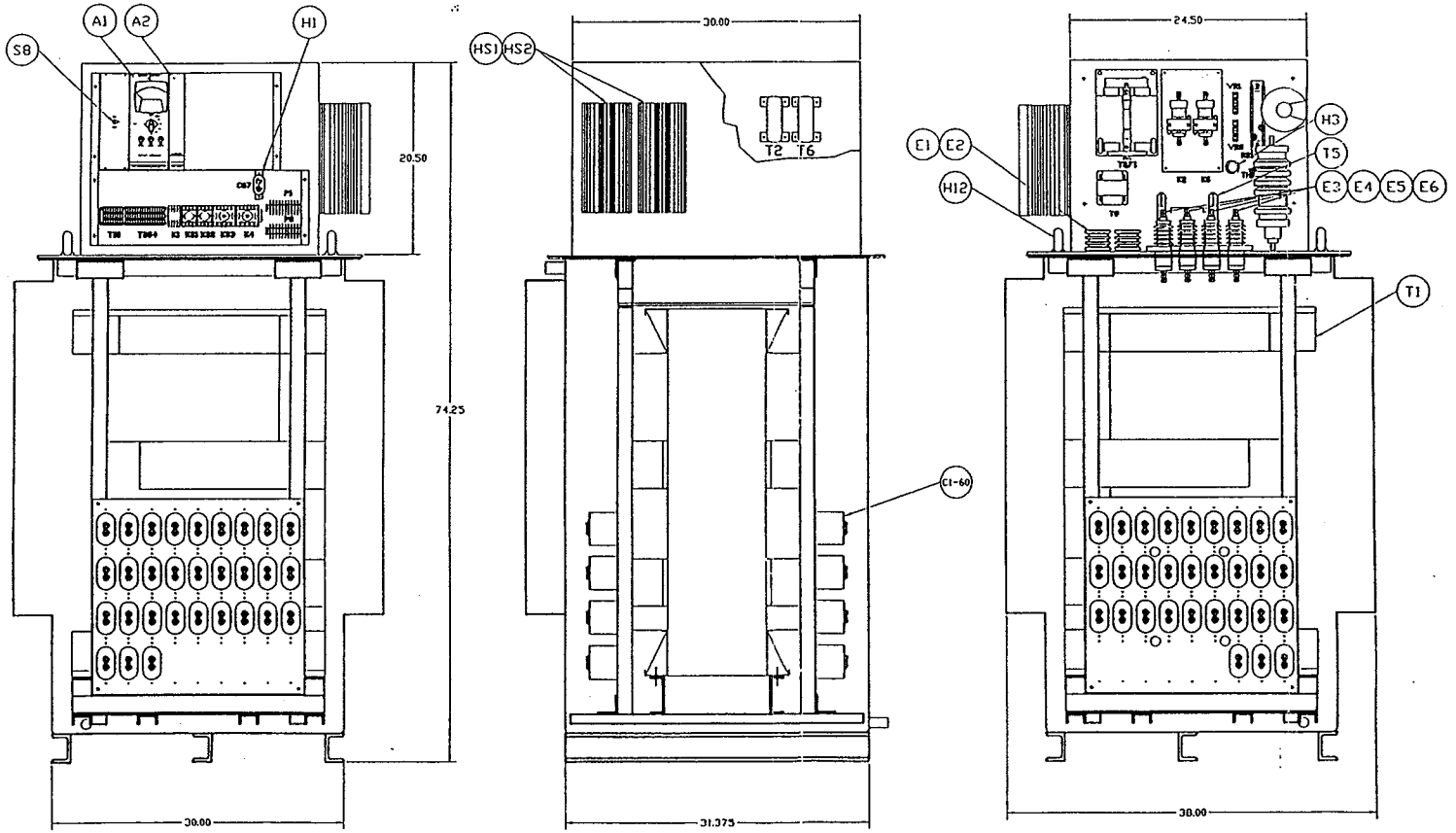
11. Make sure wiring connections are tight and no wires are shorting across each other.

CAUTION

Incorrect wiring can damage regulator. Double check all connections.

12. With regulator turned off, energize remote control lines using remote control panel, and check for proper voltages on input of remote control terminal block TB1. Insure that the voltage on the lines not energized is less than 40 V ac (for 120 V ac remote control only). If voltage is greater than 40 V ac, the defective remote control wires must be corrected.
13. Energize regulator and set rotary selector switch of the REM position. Operate the CCR by remote control, and verify correct current levels are obtained on all brightness steps.
14. Turn rotary selector switch S2 to OFF and deenergize regulator (disengage disconnect switch or main circuit breaker). Remove short-circuit link from output bushings.
15. Connect the 20 A series lighting circuit to the output bushings and tighten all connections.

Check if the *input current x input voltage x CCR efficiency = 0.93* (for 50 kW CCR) *or 0.94* (for 70 kW CCR) is larger than the kW rating given on the CCR's nameplate. If it is, either reduce the load or replace regulator with one having a larger kW rating.



NOTES: 1. PAINT WITH ADB BLUE.
2. H3-H27 ARE NOT SHOWN.

ADB
A Siemens Company

Figure 8-1a. 50/70 kW Final Assembly
Document No. 96A0170
Page 8-1

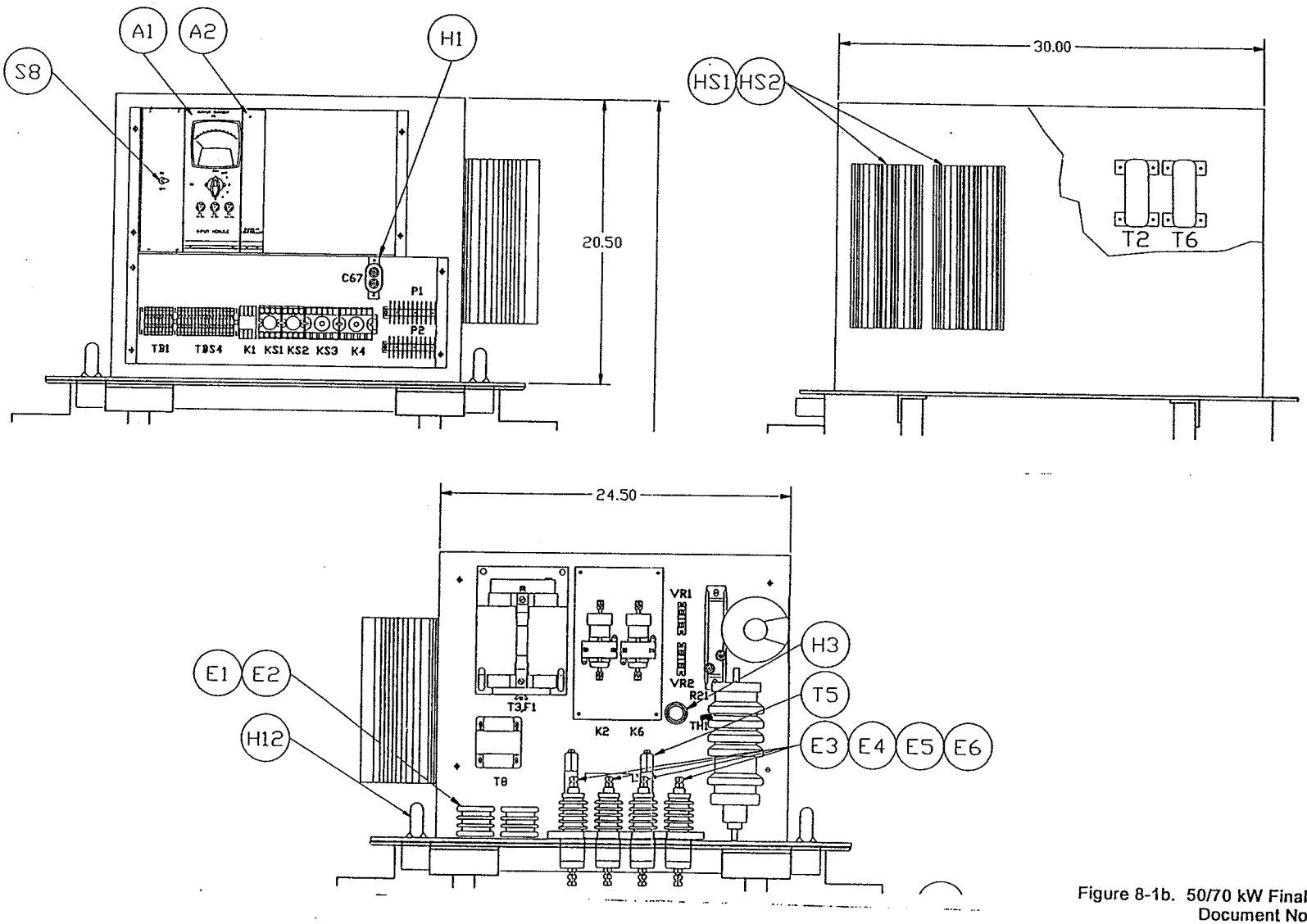
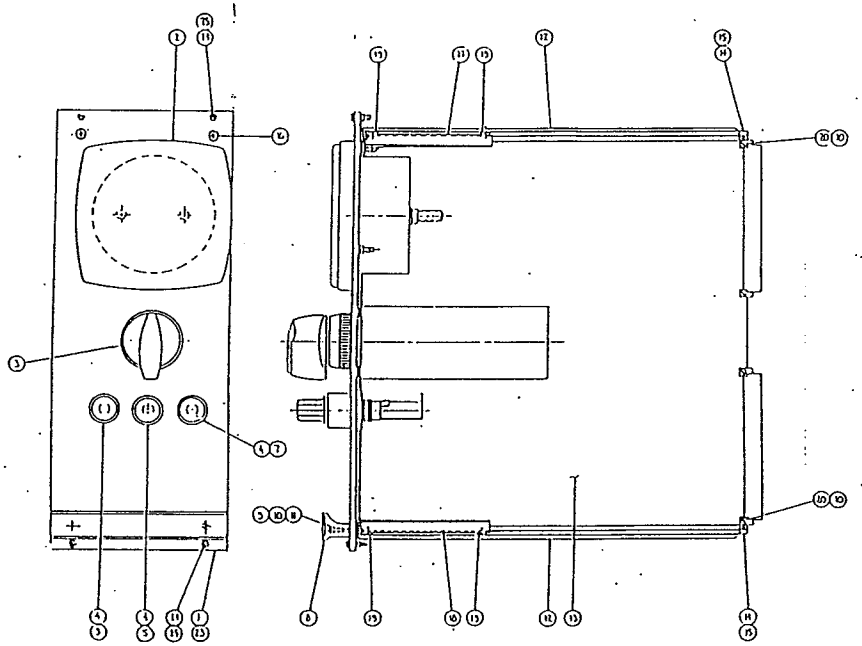


Figure 8-1b. 50/70 kW Final Assembly
Document No. 96A0170
Page 8-1.1



ITEM NO	PART NO	PART NAME / DESCRIPTION
1	60C0517	PLATE, FRONT
2	52A0098	AMMETER
3	46B0010	SWITCH
4	49A0040	FUSEHOLDER
5	47A0049	FUSE, 2A, 250V S.B.
7	47A0068	FUSE 0.1A, 250V S.B.
8	63A0401-2	HANDLE
9	64A0231-6	SCREW RD HD/PHILLIPS
10	66A0079-12	LOCKWASHER SPLIT M2.5
11	65A0149-12	NUT, HEX M2.5
12	63A0394	GUIDE, PCB, 220MM
13	44D1133	INPUT MODULE P.C.B. ASSY
14	61B0135	FIXATION P.C.B.
15	64A0231-12	SCREW RD.HD/PHILLIPS, M2.5-12
16	64A0235-12	SCREW C'SK/PHILLIPS, M2.5-12
17	60C0502-1	REINFORCEMENT, UPPER
18	60C0502-2	REINFORCEMENT, LOWER
19	64A0233-4	SCREW PAN HD/SL, M2.5-4
20	64A0233-10	SCREW, PAN HD/SL., M2.5-10
24	63A0403	INSERT, PLASTIC
25	64A0234-12	SCREW, CAPTIVE M2.5-12

DO NOT SCALE DRAWING

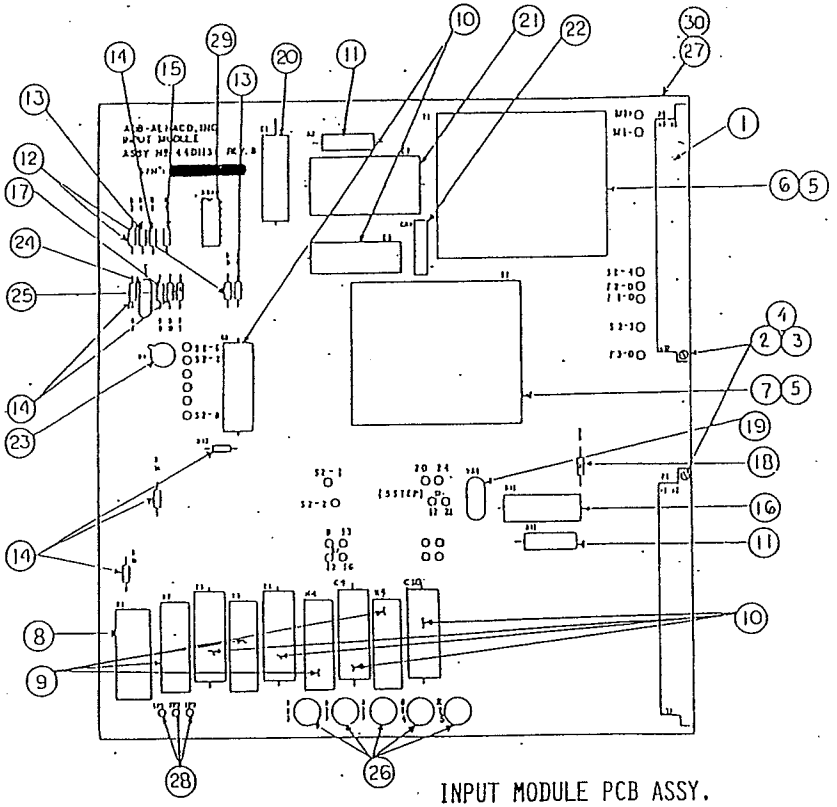
ADB ALNACO

ADB-ALNACO, INC.
P.O. BOX 20639
877 GAHANNA PARKWAY
COLUMBUS, OHIO 43230

PART NAME: INPUT MODULE ASSY

DRAWING NO. 4.4.D.1.205. REV

Figure 8-2. Input Module Assembly
Document No. 96A0170
Page 8-2



INPUT MODULE PCB ASSY.

ITEM	PART NO	DESCRIPTION	QTY
1	70A0271	CONNECTOR, MALE/32C./DIN	2
2	6A40233-10	SCREW, PAN HD./SLOTTED M2.5x10	2
3	66A0075-12	LOCKWASHER, M2.5 SPLIT	2
4	65A0145-12	NUT, HEX M2.5	2
5	6A40236-10	SCREW, SELF-TAPPING #4-24x10	4
6	35C0128	TRANSFORMER, CURRENT 6.6A/55mA	1
7	35C0133	TRANSFORMER, POWER SUPPLY	1
8	53A0175	RELAY, DPDT, COIL, 48 VDC, CONTACT 5A	1
9	53A0177	RELAY, REED, SPST, COIL, 24VDC, COIL .75A	4
10	23A0065	CAPACITOR, 6.8uF, 100V, ±10%	6
11	15A0063	RESISTOR, 2.2K OHM, 4W, ±1%	2
12	02A1001-01F	RESISTOR, 1K OHM, 1/2W, ±1%	2
13	11A0136	RESISTOR, 392 OHM, 1/4W, ±2%	2
14	01A1002-05F	RESISTOR, 10K OHM, 1/4W, ±5%	6
15	01A4703-05C	RESISTOR, 470K OHM, 1/4W, ±5%	1
16	15A0062	RESISTOR, 15 OHM, 4W, ±1%	1
17	01A2202-05C	RESISTOR, 22K OHM, 1/4W, ±5%	1
18	27A0048	DIODE	1
19	32A0019	VARISTOR	1
20	22A0050	CAPACITOR, 68uF, 60V	1
21	22A0051	CAPACITOR, 1000uF, 63V	1
22	27A0047	DIODE, BRIDGE RECTIFIER	1
23	29A0034	TRANSISTOR	1
24	23A0061	CAPACITOR, 0.1uF, 100V, ±10%	1
25	27A0008	DIODE, SWITCHING	1
26	18A0030	POTENTIOMETER, 5K OHM, 1W, ±5%	5
28	66A0047	TEST POINT	3
29	37A0005	INTEGRATED CIRCUIT, OP-AMP, DUAL	1

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ADB ALNACO ADB-ALNACO, INC
P.O. BOX 30035
833 CHESHIRE PARKWAY
COLUMBUS OHIO 43230

PART NAME
INPUT MODULE PCB ASSY
5 STEP

RAW STOCK NO	MASS	
NEXT ASSEM	DRWG BY	DATE
SCALE	DRAWN BY	PAGE
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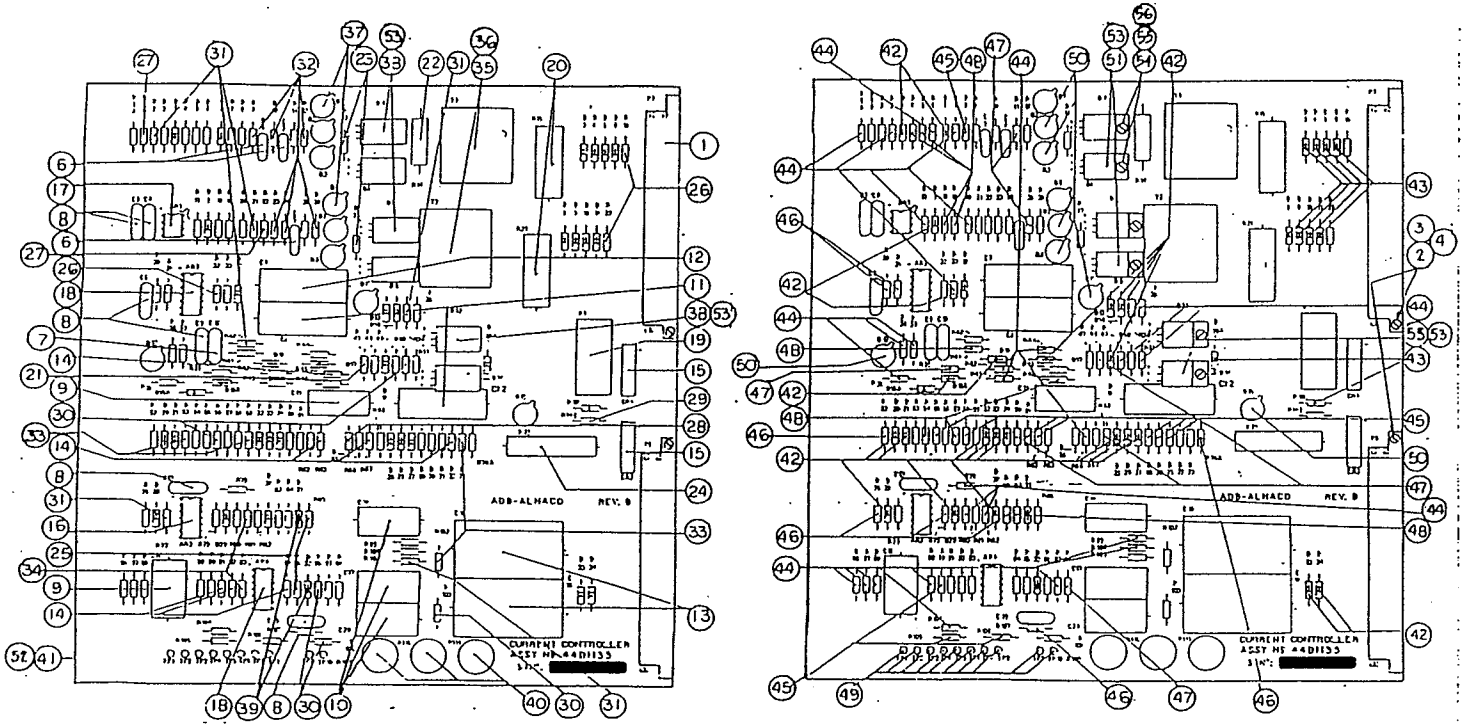
4.4.D.1.1.3.3.		A

Figure 8-3. Input Module PCB
Document No. 96A0170
Page 8-3



CURRENT CONTROLLER PCB ASSY.

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ADB ALNACO

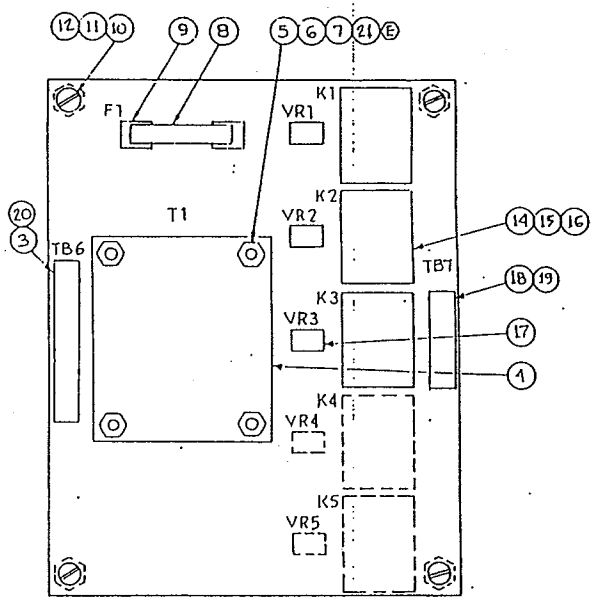
ADB-ALNACO, INC.
P.O. BOX 30029
877 GAHANNA PARKWAY
COLUMBUS, OHIO 43230

PART NAME:

44D1269

ITEM NO	PART NO	PART NAME / DESCRIPTION	QTY
1	70A0271	CONNECTOR, MALE/32C./DIP	2
2	6MA0233-10	SCREW, PAN HD./SLOTTED M2.5x10	2
3	66A0075-12	LOCKWASHER, #2.5 SPLIT	2
4	65A0105-12	NUT, HEX M2.5	2
5	29A0036	TRANSISTOR	1
6	21A0037	CAPACITOR, 22nF, 500V, ±10%	3
7	23A0060	CAPACITOR, 0.022uF, 250V, ±10%	1
8	23A0061	CAPACITOR, 0.1uF, 100V, ±10%	6
9	23A0062	CAPACITOR, 0.22uF, 100V, ±10%	2
10	23A0063	CAPACITOR, 1uF, 100V, ±10%	3
11	23A0064	CAPACITOR, 4.7uF, 100V, ±10%	2
12	23A0065	CAPACITOR, 6.8uF, 100V, ±10%	1
13	22A0052	CAPACITOR, 2200uF, 40V	2
14	11A0141	RESISTOR, 47.5K OHM, 1/4W, ±1%	2
15	27A0047	DIODE, BRIDGE RECTIFIER	2
16	37A0005	INTEGRATED CIRCUIT, OP-AMP, DUAL	1
17	37A0006	INTEGRATED CIRCUIT	1
18	37A0007	INTEGRATED CIRCUIT	2
19	53A0175	RELAY DPDT, COIL, 48 VDC, CONTACT 5A	1
20	17A0002	RESISTOR, 4.42 OHM, 7W ± 1%	2
21	01A4703-05C	RESISTOR, 470K OHM, 1/4W, ±5%	1
22	13A0025	RESISTOR, 1Ω, 1W, ± 5%	1
23	02A1000-05C	RESISTOR, 100 OHM, 1/2W, 5%	2
24	15A0064	RESISTOR, 470 OHM, 5W	1
25	11A0137	RESISTOR, 681 OHM, 1/4W, ±1%	2
26	02A1001-05C	RESISTOR, 1K OHM, 1/2W, ±5%	3
27	01A3301-05C	RESISTOR, 3.3K OHM, 1/4W, ±5%	2
28	01A1501-05F	RESISTOR, 1.5K OHM, 1/4W, ±5%	1
29	11A0138	RESISTOR, 4.75K OHM, 1/4W, ±5%	1
30	01A1502-05F	RESISTOR, 15K OHM, 1/4W, ±5%	5
31	11A0139	RESISTOR, 22.1K OHM, 1/4W, ±5%	6
32	01A3302-05C	RESISTOR, 33K OHM, 1/4W, ±5%	6
33	11A0140	RESISTOR, 27.4K OHM, 1/4W, ±1%	4
34	01A1004-05C	RESISTOR, 1M OHM, 1/4W, ±5%	2
35	35C0124	TRANSFORMER, TRIGGER	2
36	6MA0236-10	SCREW, SELF-TAPPING, #4-24x10	4
37	29A0035	TRANSISTOR	2
38	29A0036	TRANSISTOR	3
39	27A0049	DIODE, ZENER, 6.2V, REFERENCE	2
40	18A0030	RESISTOR, VARIABLE, 5K OHM, 1W, ±5%	3
42	27A0008-1	DIODE, SWITCHING	24
43	27A0048	DIODE	10
44	01A1002-05F	RESISTOR, 10K OHM, 1/4W, ±5%	28
45	11A0142	RESISTOR, 56.2K OHM, 1/4W, ±1%	11
46	01A1003-05F	RESISTOR, 100K OHM, 1/4W, ±5%	8
47	01A1503-01F	RESISTOR, 150K OHM, 1/4W, ±1%	7
48	01A3323-05F	RESISTOR, 332K OHM, 1/4W, ±5%	9
49	66A0099	TEST POINT	10
50	29A0034	TRANSISTOR	7
51	29A0037	TRANSISTOR	2
53	85A0053	INSULATOR	6
54	6MA0138-4	SCREW, PAN HD. #6-32 x ¼	6
55	66A0070-4	LOCKWASHER, #6 EXT. TH.	6
56	65A0015-11	NUT HEX #6-32	6

Figure 8-4. Current Controller PCB
Document No. 96A0170
Page 8-4



ITEM NO.	PART NO.	PART NAME / DESCRIPTION	QTY
3	72A0116-2	CONNECTOR	1
4	35A0220	TRANSFORMER	1
5	64A0194-20	SCREW, RD HD #6-32 x 1 1/2	4
6	66A0036-11	LOCKWASHER, SPLIT #6	4
7	65A0015-11	NUT, HEX #6-32	4
8	47A0017	FUSE	1
9	47A0067	FUSE CLIP	2
10	64A0177-8	SCREW, PAN HD #10-32 x 1/2	4
11	66A0057-10	STAND OFF, 3/8 HEX x 5/8 LG	4
12	66A0038-5	LOCKWASHER INT.TH. 10	4
13	B9A0002-9	WIRE, AWG 22, 600V, WHITE	A/R
14	49A0066	SOCKET RELAY	SEE TABLE
15	55A0185	RELAY	
16	61A0131	SPRING, RELAY, HOLD-DOWN	
17	32A0013	VARISTOR	
18	72A0116-3	CONNECTOR	1
19	72A0117-3	PLUG, P.C. CONNECTOR	1
20	72A0117-2	PLUG, P.C. CONNECTOR	1
21	66A0055-8	SPACER, #6, 1/2 LG	4

DASH NUMBER	PCB ASSY NO.	ITEM 14	ITEM 15	ITEM 16	ITEM 17
3 STEP	44B1735-1	3	3	3	3
5 STEP	44B1735-2	5	5	5	5

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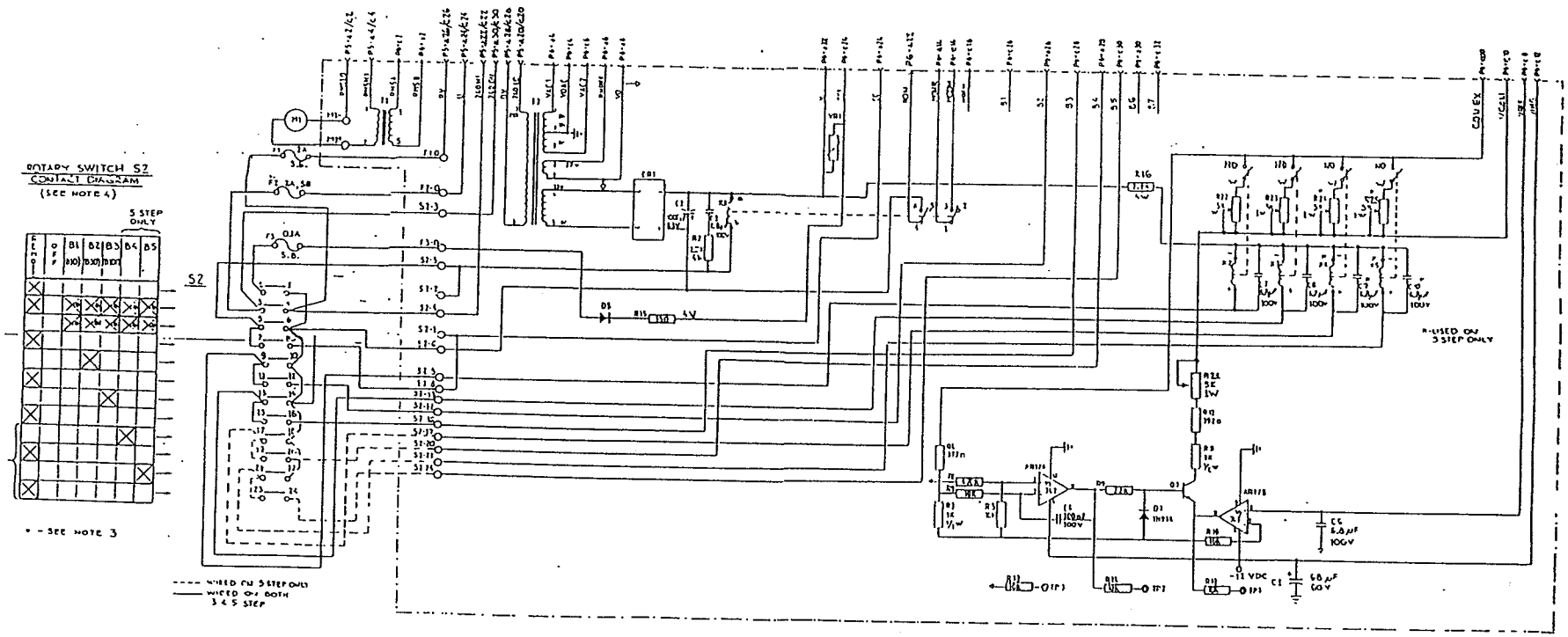
ADB ALNACO

ADB-ALNACO, INC.
P.O. BOX 30028
977 GAHANNA PARKWAY
COLUMBUS, OHIO 43230

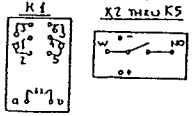
PART NAME:
INTERFACE PCB ASSY,
120VAC, 3 STEP OR 5 STEP LB28/B29

DRAWING NO. 44B1235-X REV E

Figure 8-5. 120 VAC to 48 VDC Interface



RELAY
WIRING DIAGRAMS
(BOTTOM VIEW)



NOTES:

1. RELAYS SHOWN DEENERGIZED.
2. USED ON 5 STEP ONLY: K4, K5, R14, R15, C9, C10 AND CONTACTS 17-24 ON ROTARY SWITCH S2.
3. DENOTES MAKE - BEFORE - BREAK CONTACT (SHORTING).
4. ROTARY SWITCH S2 HAS 7 POSITIONS. AN "X" IN THE COLUMN DIRECTLY ACROSS FROM CONTACT DETERMINES THE POSITION A CONTACT IS SHORTED. FOR EXAMPLE, A SHORT OCCURS BETWEEN PINS 9 AND 10 WHEN THE ROTARY SWITCH IS IN POSITION "B2."
5. WIRES FROM FRONT PANEL TO PCB ARE AWG 20, 1000 V.
6. RESISTORS 1/4 W UNLESS OTHERWISE SPECIFIED.

Figure 8-6. Input Module Schematic
Document No. 96A0170
Page 8-6

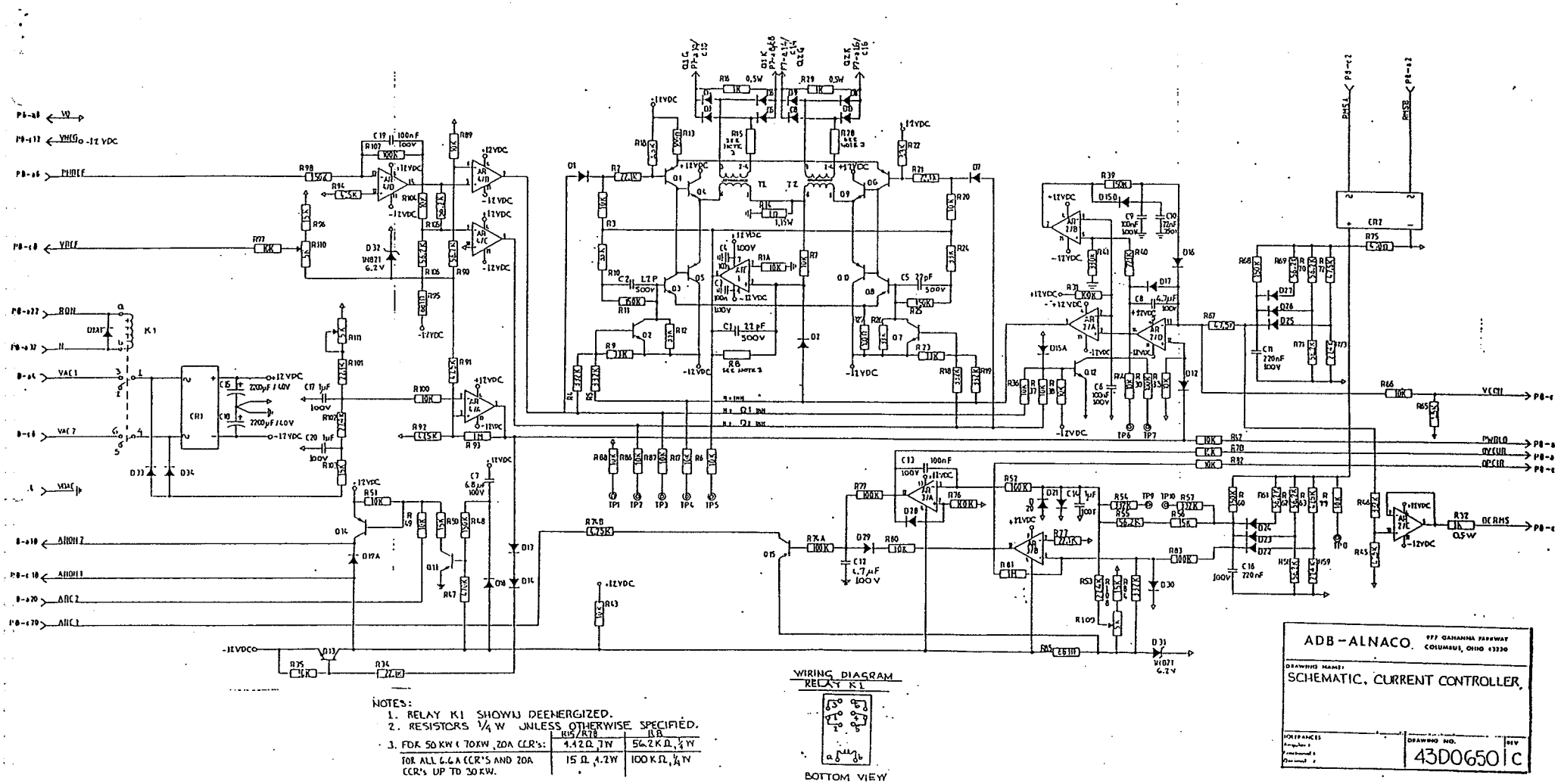


Figure 8-7. Current Controller Schematic
Document No. 96A0170
Page 8-7

P3 / P4 INPUT / OUTPUT SIGNALS

SIGNAL NAME	DESCRIPTION
RMSLO	SEC. OF CURR. TRNSFR. 6.6/6.6A OR 20/6.6A EARTH CONNECTED.
RMSHI	SEC. OF CURR. TRNSFR. 6.6/6.6A OR 20/6.6A
SCRxK	SCR x, CATHODE
SCRxG	SCR x, GATE
240LO	240V IN PHASE WITH REGULATOR SUPPLY
240HI	240V IN PHASE WITH REGULATOR SUPPLY
U'	240V AFTER FUSE F2
RV	240V AFTER FUSE F1
DV	RV AFTER EXTERNAL STRAP
240 ON	240V AFTER LOCAL/REMOTE SWITCH
240 SP	240V SPARE
ARON 1	CONTROL VOLTAGE FOR COIL OF KON
ARON 2	" " " " " "
ARC 1	FIRST NORMAL OPEN CONTACT OF KON
ARC 2	" " " " " "
CCI	POWER SUPPLY FOR REMOTE CONTROL SOURCED BY INPUT MODULE
CC	REGULATOR ON REQUEST
Bx	BRIGHTNESS x REQUEST
H	COMMON FOR REMOTE CONTROL

INTERNAL SIGNALS

SIGNAL NAME	DESCRIPTION
RMSA	SEL OF CURR. XMER 6,6/0,055A
RMSB	" " " " " "
VOAC	0 VOLT AC FROM INPUT MODULE
VAC1	AC VOLTAGE " " "
VAC2	" " " " "
PHREF	PHASE REFERENCE VOLTAGE FROM INPUT MODULE
VREF	OUTPUT CURRENT REFERENCE VOLTAGE (6,6A)
VO	0 VOLT REFERENCE LINE
VCON	OUTPUT CURRENT CONTROL VOLTAGE
CONEX	6,6A OR 20A REQUEST IF CONNECTED TO VREF
VNEG	NEGATIVE SUPPLY VOLTAGE FROM CURRENT CONTROLLER
RON	48V SIGNAL FOR ON/OFF CONTROL
PELI	PREVENTS E.L - INDICATION IN CASE OF PWRLO, OPCIR OR OVCUR

P13 / P14 INPUT / OUTPUT SIGNALS

SIGNAL NAME	DESCRIPTION
0VAC	LOGIC ZERO VOLT
15 VAC 1 15 VAC 2	POWER SUPPLY: 15 VAC WITH RESPECT TO 0 VAC POWER SUPPLY: 15 VAC WITH RESPECT TO VAC 1 AND OPPOSITE PHASE WITH RESPECT TO 15 VAC 1
IOUT VOUT	OUTPUT CURRENT MEASUREMENT OUTPUT VOLTAGE MEASUREMENT
0V I.V.	COMMON OF VOUT, VOT, IOUT MEASUREMENT CONNECTED TO GND. AND LOGIC ZERO VOLT
VOT	SEC. VOLTAGE OF OPEN CIRCUITED TRANSFORMER T6
240 LO 240 HI U' RV DV 240 ON 240 SP	240V IN PHASE WITH REGULATOR SUPPLY 240V IN PHASE WITH REGULATOR SUPPLY 240V AFTER FUSE F2 240V AFTER FUSE F1 RV AFTER EXTERNAL STRAP 240V AFTER LOCAL/REMOTE SWITCH 240V SPARE
RCS-DM RCS-B5 RCS-B4 RCS-B3 RCS-B2 RCS-COM2 WRSL	MONITOR REM. CONTROL SIGNAL - DEGRADED MODE CCR REM. CONTROL SIGNAL - BRIGHTNESS STEP 5 CCR REM. CONTROL SIGNAL - BRIGHTNESS STEP 4 CCR REM. CONTROL SIGNAL - BRIGHTNESS STEP 3 CCR REM. CONTROL SIGNAL - BRIGHTNESS STEP 2 CCR REM. CONTROL SIGNAL - COMMON FOR RCS-REML RELAY CONTROL SIGNAL - NUMBER OF "LAMPS OUT" IS REACHED
FAULT A/ FAULT B/ FAULT C/ FAULT D/ FAULT E/	L = LOSS OF INPUT POWER TO THE REGULATOR L = OVERCURRENT OR OPEN CIRCUIT OF CCR L = EXCESSIVE VA - DROP IN LOOP L = INCORRECT OUTPUT CURRENT OF CCR L = EXCESSIVE NUMBER OF LAMP FAILURES IN LOOP
OVL/	L = OUTPUT CURRENT BELOW MINIMUM LEVEL AND OUTPUT VOLTAGE ABOVE NOMINAL LEVEL AT BRIGHTNESS STEP 5
RCS-REML	CCR REM. CONTROL SIGNAL - REMOTE/LOCAL SWITCH
RCS-B(X)	CCR REM. CONTROL SIGNAL - BRIGHTNESS STEP (X)
RCS-CC	CCR REM. CONTROL SIGNAL - ON SIGNAL
RCS-B(Y)	CCR REM. CONTROL SIGNAL - BRIGHTNESS STEP (Y)
ARCL	RELAY CONTROL SIGNAL (ALARM)
VRED	INPUT POWER SUPPLY AFTER RECTIFIER
RCS-COM1	CCR REM. CONTROL SIGNAL: COMMON FOR RCS-B(X) AND RCS-CC
MCOM	MONITORING = COMMON
MONR	MONITORING = ON REQUEST
MREM	MONITORING = CCR REMOTELY CONTROLLED

SIGNAL SOURCE
CONNECTION POINT:SIGNAL USED
\- - - :SIGNAL CONTINUING

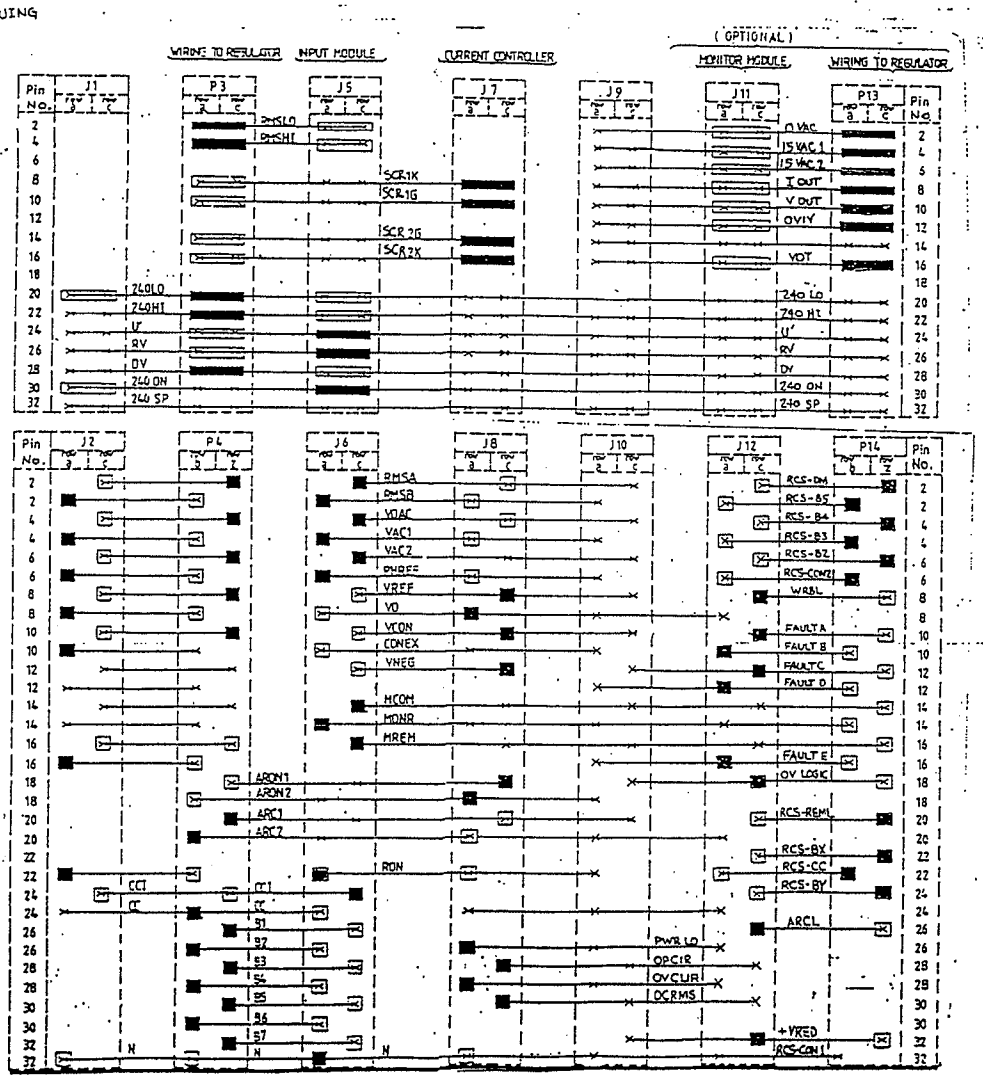


Figure 8-8. Motherboard
Document No. 96A0170
Page 8-8

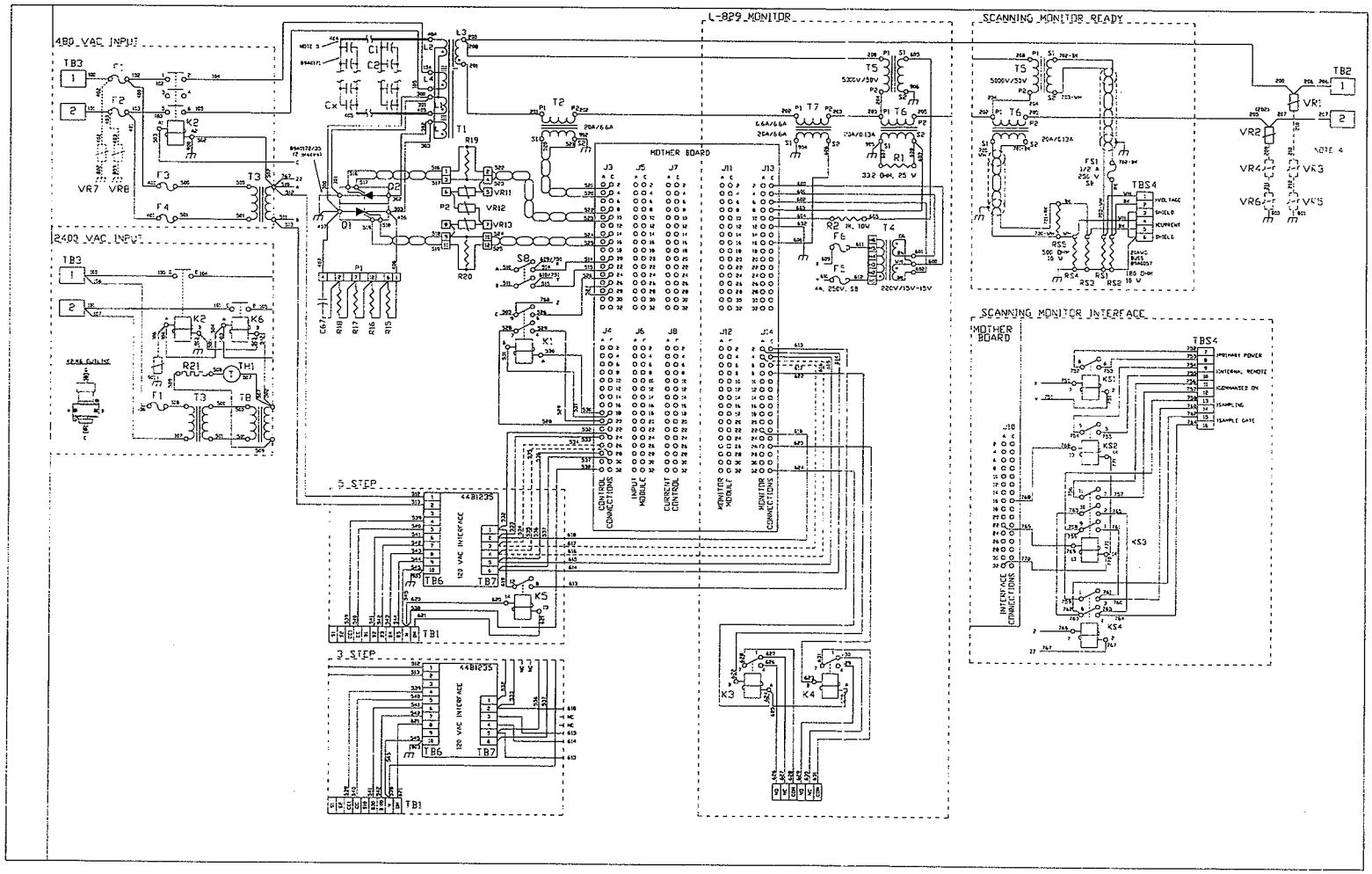
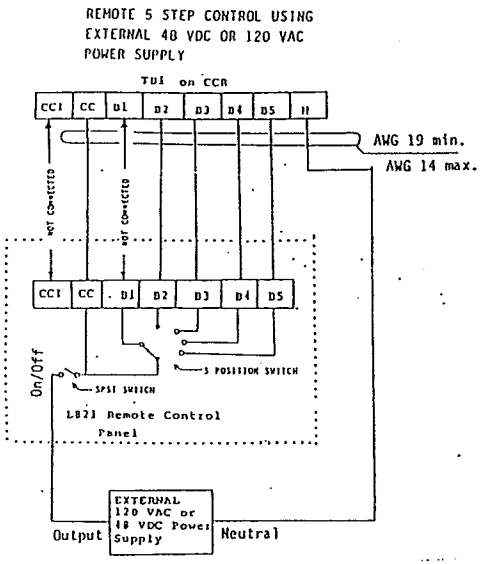
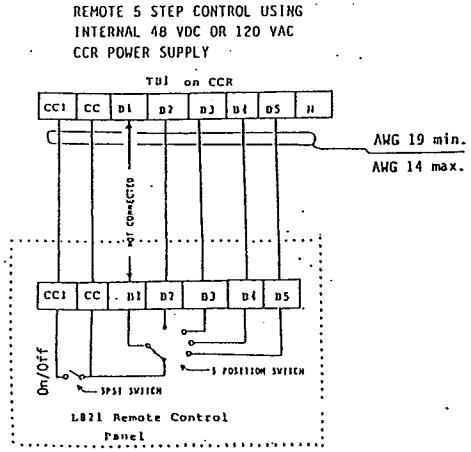
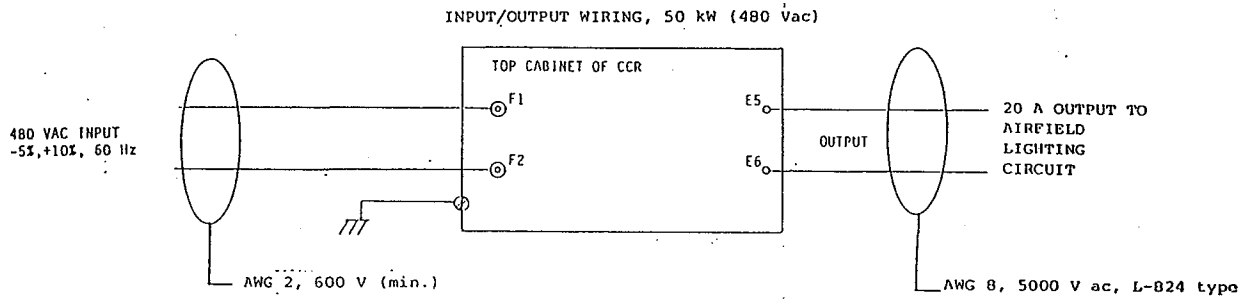


Figure 8-9. L-828 50 and 70 kW/20 A Wiring Schematic (2400 Vac)







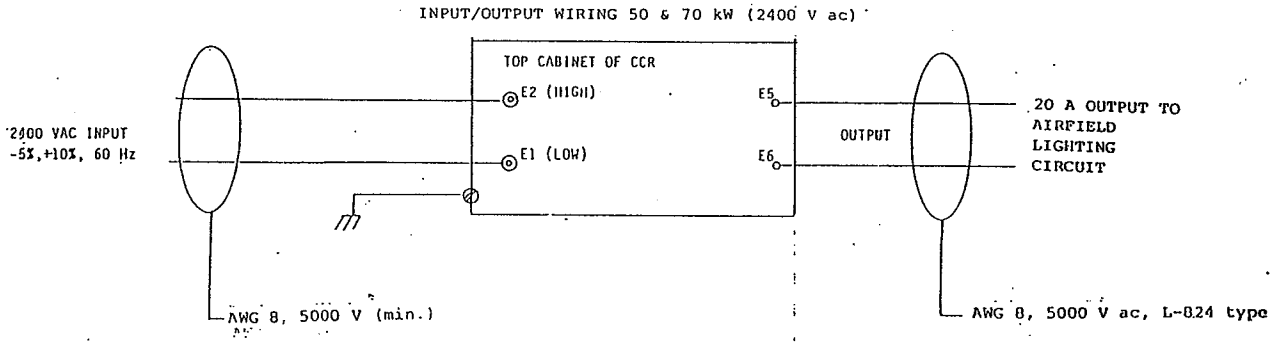


Figure 8-10. External Wiring/Remote Control Connections